

4 AFFECTED ENVIRONMENT, IMPACTS, AND MITIGATION

4.1 PHYSICAL ENVIRONMENT

4.1.1 Geology and Soils

The island of Kaua‘i is composed of a single basalt shield volcano built by the extrusion of lava of the Waimea Canyon Volcanic Series during the late Pleistocene Epoch (more than two million years ago). Following the cessation of this main shield building phase, there was renewed volcanic activity with the extrusion of basaltic lava of the post-erosional Koloa Volcanic Series. Therefore, the majority of the Kaua‘i is covered by lava of the Waimea Canyon Volcanic Series, but rocks of the Koloa Volcanic Series cover most of the eastern half of the island. These rocks generally are characterized as thick flows of dense basalt extruded from groups of vents aligned in north-south trends in various locales.

The weathering process has formed a mantle of residual soils that grade to saprolite with depth. In general, saprolite is composed of mainly silty materials and is typical of the tropical weathering of volcanic rocks. The saprolite grades to basaltic rock formation with increasing depth.

Along streams, drainage ways, and low-lying areas, erosion of the upper Koloa and Waimea Canyon Volcanic Series has deposited alluvial sediments. These sediments generally are unconsolidated to moderately consolidated, non-calcareous soil deposits.

Based on preliminary geotechnical investigations, the path alignment will traverse recent alluvial soils, weathered volcanic rock, and beach deposits (in the order of most to least encountered within the project area) (Geolabs, April 2004).

Recent Alluvium

The majority of the proposed path alignment is underlain by recent alluvial deposits, characterized as unconsolidated, non-calcareous soils. These recent alluvial deposits, typically found along drainage ways and low-lying areas, tend to be soft in consistency and compressible when subjected to loading.

Weathered Volcanic Rock

Based on geologic maps, portions of the path alignment are underlain by basalt rock formations of the Koloa Volcanic Series. The presence of stiff residual and saprolitic soils are anticipated near the ground surface. These soils were developed and derived from the in-situ weathering of the basaltic formation. Volcanic deposits are anticipated within the Wailua House Lots and Kawaihau areas.

Beach Deposits

Beach deposits generally consist of unconsolidated calcareous sediments composed largely of fragments of marine organism. These deposits typically are encountered along the shoreline areas.

4.1.2 Topography

The terrain along the proposed path alignment varies from level, low-lying areas to sloping hillside areas. The majority of the path alignment is on generally level, low-lying areas with ground surface elevations ranging from about sea level to +20 feet Mean Sea Level (MSL).

In the Wailua House Lots area, ground surface elevations rise to about +130 feet MSL. Slopes incline toward the west and range from about ten horizontal units to one vertical unit (10H:1V) near the coastal plain, to 50H:1V closer to Nounou Mountain. Another area with increasing ground surface elevations is the Kawaihau area. Existing ground surface elevations in the Kawaihau area increase to more than +130 feet MSL. The ground surface generally slopes upward to the north at about 5H:1V to 10H:1V slope inclinations.

Potential Impacts and Mitigation Measures

Impacts of Soil, Subsurface, and Topographic Conditions on the Proposed Path

Several types of geotechnical considerations may have the potential for impacts on the stability of the planned facility, as well as the future maintenance of the proposed path. The geotechnical considerations may include, but are not limited to, the following:

Settlement Due to Soft Soils

The proposed alignment is likely to encounter areas underlain by recent alluvium that are susceptible to consolidation and settlement over time as man-made fills are placed over these soft ground areas. Soft soils likely will be found at stream crossings, drainage ways, and other localized areas. A detailed field exploration will be performed during the design stage at locations where soft soil deposits are suspected in order to determine the lateral extent and thickness, and consolidation characteristics under the proposed fill loading conditions. The soft soil areas will be further evaluated to provide recommendations for design and construction of embankments and/or bridge structures over these areas. Typical methods to reduce anticipated path settlement and to increase pavement stability include removing the soft and/or loose soil deposits and replacement with compacted fill materials, installation of a working platform or drainage blanket prior to fill placement, and utilizing soil stabilization methods to improve the soft and/or loose soil deposits for construction.

In addition, a settlement waiting period likely will be required for embankment construction over soft ground areas to reduce the potential for shear failure in soft material and to reduce

post-construction settlements of the embankment. A surcharge program with settlement monitoring may reduce the settlement waiting period.

Rockfall Hazard

Areas adjacent to relatively steep mountain sides and hillsides are susceptible to rockfall. Rockfall involves the detachment and fall of rock material from the slope face that can present potentially hazardous conditions for the path user. The only area where this condition would be of concern is located near Mahelona Memorial Hospital. More detailed geologic and geotechnical studies will be conducted in these areas to evaluate the potential for rockfall hazards along these stretches of the path during engineering and design of the path.

Flooding by Rainfall

The island of Kaua‘i contains numerous rivers, streams, and drainage ways as a result of the high volume of tropical rainfall. Extended periods of heavy rainfall may swell drainage ways to their capacity and flood low-lying areas.

Impacts of the Path on Soil, Subsurface, and Topographic Conditions

Path improvements are not expected to have an adverse impact on the overall topography in the project corridor, which is generally flat. In many areas, the land is already used for a transportation purpose, either formally or informally, as existing or former roads, trails, and footpaths. Topographic changes are expected to be greater in smaller, localized areas that have steeper slopes, for example, through Kawaihau gulch below Mahelona Hospital. Construction of the path in these areas will involve excavation and grading work, or cutting into the slope and building retaining walls. To the extent practical, design plans developed for the path in these areas will try to achieve balanced cut and fill conditions to minimize disturbances to the area’s topography and soils, and the need to transport and possibly dispose of surplus material.

Construction of the path and amenities will inevitably involve some land disturbing activities that may result in waterborne and airborne soil erosion. However, the erosion potential is considered relatively low given the small areas of disturbance in any given location. To minimize the potential for construction-related erosion impacts, best management practices (BMPs) will be developed as part of the project’s engineering and design. Erosion and sedimentation control measures will include:

- Use of temporary berms and cut-off ditches
- Use of temporary silt fencing and screens
- Regular watering of graded areas as a means of reducing the amount of fugitive dust in the air
- Sodding or planting of slopes immediately after grading work has been completed
- Restrictions on the stockpiling of construction material and proper disposal of construction debris

All erosion and sedimentation control measures will comply with the County’s regulations. Other mitigation measures will be specified as part of applicable National Pollutant Discharge Elimination System (NPDES) permits obtained from the State Department of Health as part of the Clean Water Act.

4.1.3 Climate and Air Quality

Kaua‘i, like the rest of the state, enjoys good air quality and meets the standards set by the Clean Air Act (i.e., it is within an “attainment area”). Air quality issues applicable to this project will involve short-term, construction-related emissions, such as fugitive dust. The proposed improvements will not increase chemical air pollutants that are regulated under State and Federal standards, such as sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone, and lead. In the long-term, the proposed action may have positive impacts as path users replace automotive trips with non-motorized travel, since vehicular traffic is a primary source of carbon monoxide emissions.

Potential Impacts and Mitigation Measures

Short-term, Construction-related Emissions

Short-term impacts on air quality along the study corridor may result from construction of the path. However, such impacts are expected to be negligible because of their limited duration and the ability of best management practices to minimize emissions. Two common types of pollutants are (1) fugitive dust emissions from vehicular movement and soil excavation, and (2) exhaust emissions from on-site construction equipment.

Fugitive Dust. A dust control plan that incorporates best management practices will be implemented to minimize air quality impacts during the project construction phase. Among the measures available to control airborne emissions are the following:

- Erect dust screen barriers during construction
- Cover stockpiles with appropriate material and dispose of debris properly
- Water active work areas, as necessary, to control dust
- Keep clean adjacent paved roads
- Cover open-bodied trucks whenever hauling material that can be blown away
- Limit the amount of disturbed area at any given time and/or stabilize inactive areas that have been exposed

Exhaust Emissions. Emissions from the engine exhausts of on-site mobile and stationary construction equipment will have minimal impacts on air quality. Emission impacts can be reduced by requiring contractors to use vehicles that are properly maintained. Nitrogen oxide emissions from diesel engines can be relatively high compared to emissions from gasoline-powered equipment; however, the standard for nitrogen dioxide is set on an annual basis and is unlikely to be violated by emissions from short-term use of construction equipment. Carbon monoxide emissions from diesel engines are low and expected to be relatively small compared to vehicular emissions on nearby roadways.

Construction activities will employ fugitive dust emission control measures in compliance with provisions of the State Department of Health Rules and Regulations (Chapter 43, Section 10), and Hawai‘i Administrative Rules (HAR), Chapter 11-60.1, “Air Pollution Control,” Section 11-60.1-33 on Fugitive Dust.

4.1.4 Coastal Resources and Processes

Bathymetry and Coastline

The project site is located on the windward shore of the Kaua‘i, directly exposed to tradewinds and tradewind-generated waves. The shoreline varies considerably along the proposed route of the path. Immediately north of the Wailua River is a small embayment, in which Wailua Beach is situated. There is little visible reef offshore and the beach width here is the widest in the project area. Tradewind waves break directly off the beach, which is relatively wide and flat.

Existing Shoreline Conditions

Lydgate Park/Wailua River Bridge

The proposed path begins at the existing bike/pedestrian path cul-de-sac near the Aloha Beach Resort and moves north where it meets and follows Kūhiō Highway along the bridge that spans the Wailua River. The river on the south runs approximately perpendicular to the road, which is at a higher elevation than the riverbank. Approaching the river, the strip of land along the road becomes increasingly narrow and a revetment has been constructed to stabilize the bank (Photo 1). The slope adjacent to the revetment on the south is stabilized by vegetation, including trees and naupaka. The bridge itself shows signs of repair. There are numerous visible areas of restoration, including gunite patches (Photo 2). An overview of the area and photo locations are shown in Figure 10.

Initially, there will be enough land to construct the shared use path in the same manner as the existing concrete path. Starting approximately 200 feet south of the Wailua River cane haul bridge, the shoulder becomes too narrow and the path will have to be elevated over the bank, through and above the existing vegetation. The bike path is then proposed to cross the river as a structure cantilevered to the cane haul bridge.



LEGEND
←● Photo Location

Figure **10**
Wailua Beach



Photo 1. Revetment on South Side of Wailua River Bridge.



Photo 2. Wailua River Bridge.

Wailua River Bridge to Seashell Restaurant

The north side of the Wailua River cane haul bridge is supported in a manner similar to the south side and transitions into a vegetation-stabilized bank (Photo 3). The road elevation decreases and the slope from the road becomes gentler. The beach here is quite wide and the back beach area is well vegetated with beach morning glory and naupaka. A low uncemented rock wall stabilizes the shoulder of the road (Photo 4), which is located 125 to 225 feet inland of the shoreline. The wall transitions into an approximately 3.5-foot high vertical Cement Rubble Masonry (CRM) wall that runs along the shoulder of the road (Photo 5).

Wailua Beach is about 2,000 feet in length, measured from the Wailua River to the Seashell Restaurant and appears to be stable. The coral reef offshore of Wailua Beach is not extensive and waves break very close to shore, as can be seen in Figure 10. The beach (Photo 6) is typically more than 100 feet wide and has a history of accretion. Figures 11 and 12 present the results of an aerial photographic analysis of shoreline erosion in the area (Makai Ocean Engineering and Sea Engineering, 1991). From 1950 to 1988, there were increases of 30 and 40 feet at Transects 21 and 22, respectively, across from the Coco Palms Hotel.

The CRM wall along Kūhiō Highway ends near a public parking area at the northern part of Wailua Beach. A resident encountered during field reconnaissance reported that waves overtopped the beach and flooded this area in the early winter of 2003-2004.

The proposed bike/pedestrian path alignment along this reach is on the makai side of the CRM wall. While the alignment is set back between 125 and 225 feet from the waterline, it is at a generally low elevation and subject to flooding during extreme storm or wave events. The path may also be subject to sand drifts at this location.

At the north end of Wailua Beach Park, the path will pass mauka of a redeveloped Seashell Restaurant, following Papaloa Road, then turning inland at Lanikai Street, crossing to the mauka side of Kūhiō Highway.

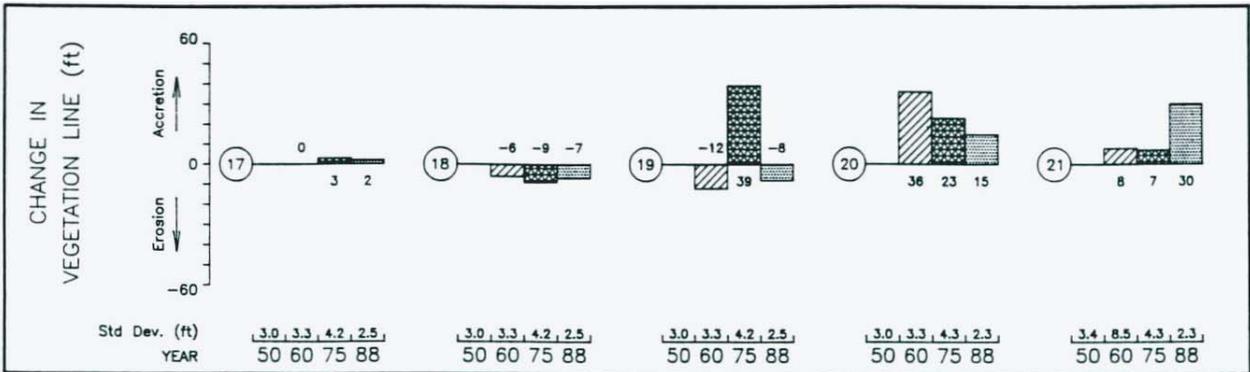
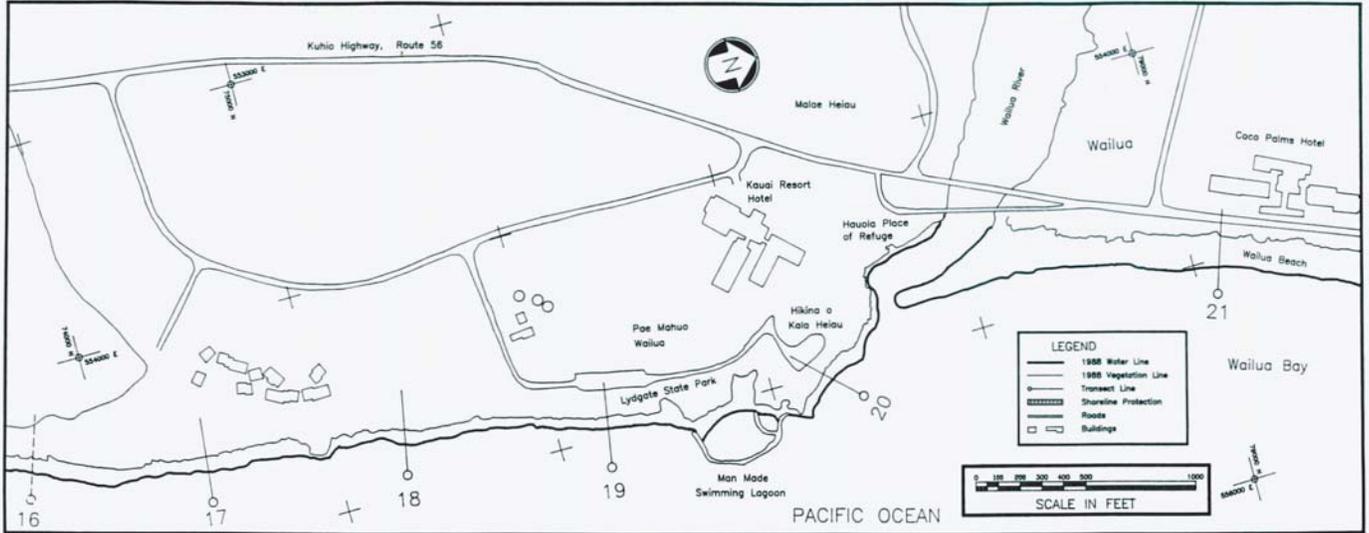


Figure 11
Aerial Photograph Erosion Analysis
 Wailua Beach and Vicinity

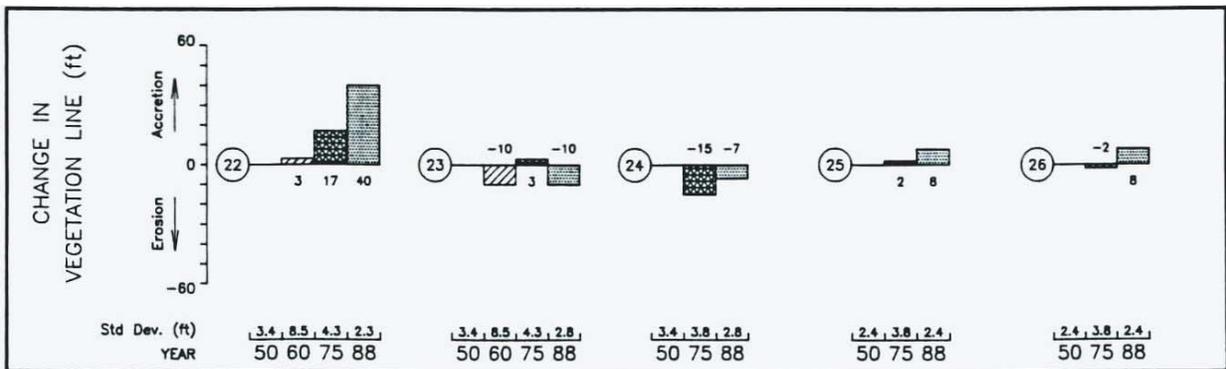
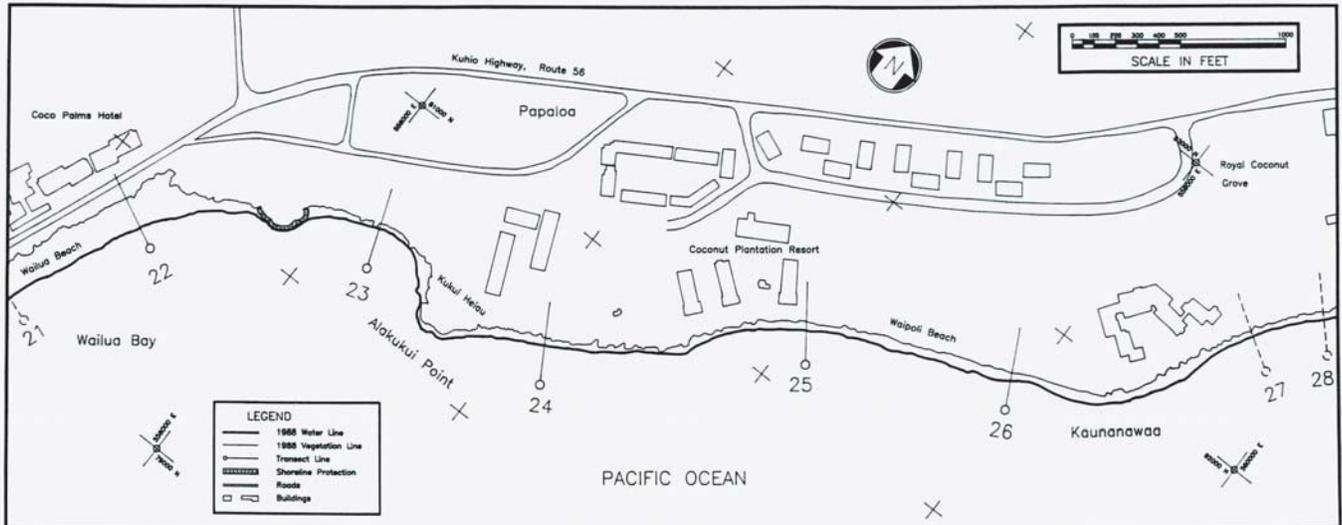


Figure **12**
Aerial Photograph Erosion Analysis
 Wailua Beach to Mokihana of Kaua'i



Photo 3. Revetment on North side of Wailua River.



Photo 4. Uncemented Rock Wall and Beach Vegetation along Kuhio Highway.



Photo 5. Transition from Uncemented Wall to CRM Wall.



Photo 6. Wailua Beach.

Waipouli Resort Area

A spur that ties into the main alignment will begin at a vacant property north of Kauai Coast Resort at the Beachboy. The path will continue past ResortQuest Kauai Beach at Makaiwa (formerly Kauai Coconut Beach Hotel), and another vacant property. Just south of Mokihaana, the path will turn mauka. This stretch of beach is typically about 50 feet wide. The shoreline is somewhat convex in front of ResortQuest Kauai. Trees run parallel to the shoreline along the back beach area, with trees fronting the vacant properties being denser than those fronting the hotels. Unpaved footpaths exist within or behind the trees fronting the vacant properties.

A beach profile was measured at the north boundary of the Kauai Coast Resort and is representative of the beach in this area. The sandy beach is 23 feet wide from the beach rock to the vegetation line with a slope of 1V:6.6H. The berm crest rises to an elevation of 11 feet MSL. The lawn areas located landward of the beach crest are typically at an elevation of about 9 feet MSL and the bike/pedestrian path is expected to be about 110 feet from the waterline.

Hurricane flooding (Sea Engineering, 2000) was calculated near the Kauai Coast Resort. The inland extent of the flooding is 433 feet, significantly beyond the proposed path. This value can be considered representative of this stretch of coast. The proposed bike/pedestrian path and property line are landward of the tree line through this section of the project area and there is expected to be no impact due to erosion.



Footpath Approaching Kauai Coconut Beach Hotel

Moanakai Road to Waika‘ea Canal

The proposed path contains another coastal section where it travels along Moanakai Road to Waikaea Canal, the project end point. A 900-foot long revetment stabilizes the southern portion of Moanakai Road, beginning near the intersection of Moanakai Road and Keaka Road (see Figure 14). The face of the revetment is slightly steeper than 1V:1H (Photo 7) and a grout cap provides a walkway (Photo 8). The road is two-way and parallel parking is allowed between the road and the revetment. The beach fronting the revetment is heavily eroded. The beach is narrow and beach rock is exposed at low tide. Further north, the revetment has a gentler sloping face and no cap, and then ends 1100 feet south of Waika‘ea Canal (Photo 9). The beach and back beach areas widen from this point to the Waika‘ea Canal and the waterline extends up to 125 feet from the road. Moanakai Road ends approximately 400 feet south of the canal. The offshore area contains a low, flat reef that extends 600 feet from shore.

Aerial photograph analyses performed across the Moanakai Road revetment, as well as further north across the unrevetted beach, are shown in Figure 13. Transect 32 shows erosion since 1950, with net erosion of 12 feet fronting the revetment from 1950 to 1988. The pattern is quite different beyond the revetment toward Waika‘ea Canal. Transects 33 and 34 show accretion. The vegetation line at Transect 33 experienced a slight amount of erosion through 1960, then 40 of accretion through 1988. The vegetation line at Transect 34 accreted 98 feet through 1975, and has experienced a total accretion of 79 feet from 1950 to 1988.

Analysis of a model hurricane shows an inundation elevation along Moanakai Road to be 10.5 feet (Sea Engineering, Inc., 2000), which would overtop the existing revetments, particularly in the northern section.

Presently, there is not enough room on Moanakai Road to accommodate travel space for two-way vehicular traffic, the shared use path, and a parking lane. The alignment of the path along Moanakai Road is contingent on the road flow direction being changed to one-way northbound. This change requires County Council approval and will be initiated by the County DPW. No coastal impact is expected due to the path’s location along the revetment. Beyond the revetment, the shared use path continues along Moanakai Road.

Past the end of the road and entering Lihi Park, the path meanders inland, mauka of the vegetation (Photo 10), and around the parking area to the footbridge across Waika‘ea Canal.

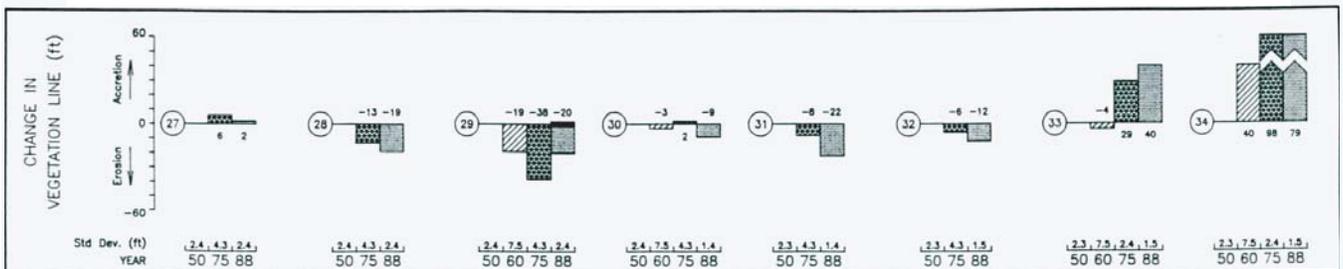
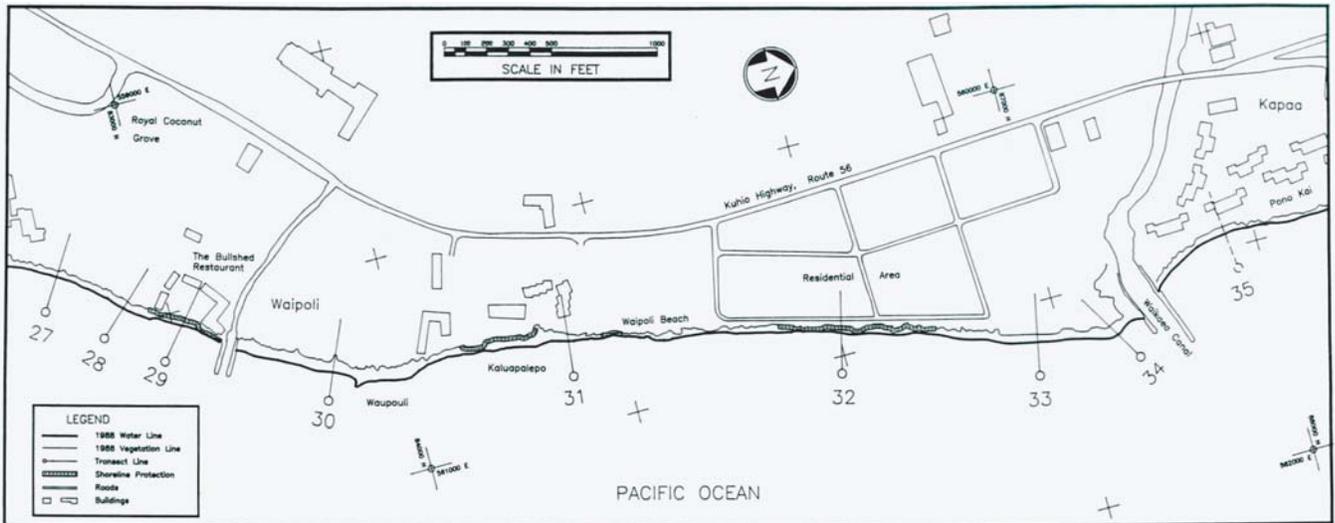


Figure **13**
Aerial Photograph Erosion Analysis
 Kau'i Coconut Beach Hotel to Kapa'a



LEGEND

- ←● Photo Location
- ◆→ Profile Location

Figure **14**
Moanakai Road to Waika'ea Canal



Photo 7. Revetment at Moanakai Road.



Photo 8. Revetment and Grout Cap at Moanakai Road.



Photo 9. Sloping Revetment at Moanakai Road.



Photo 10. Vegetation near End of Moanakai Road.

Potential Impacts and Mitigation Measures

An evaluation of the coastal environment was performed for the coastal sections of the shared use path. Background information on the wind and wave environments is discussed and the results of a field investigation were presented. The bike/pedestrian path route will be located within a County right-of-way or on County park land.

Where the path passes through Wailua Beach Park, it will be located along the mauka boundary of the park and will have no impact on beach erosion. The path will not change the availability of two ingress/egress locations into the park itself. Non-vehicular movement within the park will be enhanced.

Despite efforts to align the path as far inland as possible, the Moanakai Road section will fall within the 40-foot shoreline setback, where it will be located on stable ground just mauka of an existing revetment. Construction of the path will not involve any new hardening the shoreline.

At the north end of the project corridor, the path goes beyond Moanakai Road toward Waika‘ea Canal. Here it passes mauka of a small vegetated area along the stable shoreline. The path will be routed inland to avoid removing vegetation and into Lihi Park, where a well-trodden footpath can be seen cutting through the grassy surface.

Construction methods and materials will be selected that will minimize economic and environmental impacts in the event that the path becomes damaged. If the path is affected by extreme weather conditions, the County DPW will clear debris and make necessary repairs to ensure the safety of path users.

4.1.5 Hydrology and Water Quality

The proposed bike/pedestrian path will traverse portions of two watersheds: the Wailua-‘Ōpaeka‘a watershed and the Kapa‘a watershed.

Surface Water

Wailua-‘Ōpaeka‘a Watershed

Perennial surface water features in the lower portion of the Wailua-‘Ōpaeka‘a watershed include the Wailua River, ‘Ōpaeka‘a Stream, and a drainage canal behind the Coco Palms Hotel. Both Wailua River and ‘Ōpaeka‘a Stream are navigable for considerable distances inland. Within the lower reaches of these waterways, freshwater moves toward the shoreline in a layer overlying the saltwater. Although the Wailua River discharges into the ocean, the wave-built beach berm at the shoreline creates some restriction of the river’s discharge. As a result, the amplitude and phase of the tide are considerably reduced and lagged upstream.

Water quality in the Wailua River is generally better than in the tributaries and ditches because of more continuous flow through. Readings in the level of organic nutrients (nitrogen and phosphorous) and turbidity tend to increase moving inland.

Kapa‘a Watershed

The Kapa‘a watershed includes Konohiki Stream, an extensive network of plantation-built irrigation ditches and reservoirs, and three man-made drainage canal systems (Waipouli, Waika‘ea, and Mo‘ikeha—of which only the first two are in the project area). The canals provide flood protection for Kapa‘a Town and are the watershed’s only shoreline outlets for storm water.

Waipouli Canal System. The primary function of the Waipouli canal system is to drain stormwater from the low-lying areas inland of the south end of Kapa‘a Town. It also serves as an outlet for irrigation tailwater. At present, the only continuous source of surface water into the system is an irrigation ditch which runs around the north end of Nounou Ridge and empties into an open reservoir at the upper end of the Wailua House Lots—this irrigation also runs alongside the proposed bike/pedestrian path in the Wailua House Lots Phase. Overflow from the reservoir, which occurs continuously, flows toward the lowland areas and empties into the upper end of the canal system. The shoreline discharge point is only partially restricted by a beach berm. Water levels in low-lying portions of the canal system respond to tidal fluctuations.

Waika‘ea Canal System. Waika‘ea is the largest of the three canal systems. At present, an irrigation ditch which crosses under the temporary bypass road provides a continuous input of surface water. The canal’s shoreline outlet enables it to be free of sand blockage.

As a result, tidal variations move with virtually no attenuation or lag through the lower end of the system.

Clean Water Act, Section 303(d)

The federal Clean Water Act requires states to collect and review surface water quality data and related information, and to prepare and submit to the U.S. Environmental Protection Agency biennial lists of waterbodies that are impaired (i.e., not expected to meet State water quality standards). The current list is dated December 2002. For all impaired waters, the State Department of Health (DOH) is required to compute the Total Maximum Daily Load (TMDL), which is the maximum amount of a pollutant (from point and nonpoint sources) that a waterbody can receive and still meet water quality standards, and to establish an allocation of the maximum load to the pollutant’s sources. Because there is a large demand for TMDL calculations, the State DOH has assigned a priority of low, medium, or high to each of the impaired waters listed, based on the severity of pollution and how the water is used. There are two listings in the project area. Wailua River is impaired because of enterococci and has been assigned a medium priority for a TMDL study. Uhelekawawa Stream is listed because of turbidity and also has a medium priority.

Ground Water

In the Wailua-‘Ōpaeka‘a watershed, groundwater is pumped from wells within and above the Wailua House Lots on the east side of Nounou Ridge, tapping into the Waimea volcanics. Additional wells are located in the north end of the Kapa‘a watershed, where groundwater is drawn from the Koloa volcanics. Water levels in the Koloa volcanics range from about 7 feet wells in near-shore wells to about 13 feet further inland.

Potential Impacts and Mitigation Measures

Water Flow

The main north-south alignment will need to cross over two water channels: Wailua River and Uhelekawawa Canal. The proposed path will span these waterways with appropriately sized bridges to provide for unimpeded flow from the mauka to the makai sides of the path. As such, the flow within these waterways will not be impacted.

Water Quality

A water quality study was conducted by Tom Nance Water Resource Engineering and Marine Research Consultants in 2003 as part of background environmental studies for the proposed Kapa‘a Relief Route. The study found that water quality measures in the stream and canal systems in the Wailua-‘Ōpaeka‘a and Kapa‘a watersheds are generally within the limits set by the State Department of Health. The results were attributed to the relatively short residence time of water and continuous flow to the ocean which prevent biotic cycling from dominating water composition. The study concluded that if materials are added to the waterways as a result of activities associated with construction of new roadway segments (for example, through erosion), these materials would not stay within the streams for periods of time sufficient to promote a permanent change to the stream system. There is no reason to expect the situation to be any different for the path project; therefore, adverse effects are not anticipated. Beyond the natural flushing action discussed in the Nance/Marine Research study, waterborne erosion will be mitigated with appropriate design and best management practices in place during construction.

The Nance/Marine Research study also investigated potential contamination of surface water quality by petroleum products that may be contained in roadway runoff. Based on sample results, the study concluded that there are no consistent, measurable inputs of petroleum products to waterways adjacent to Kūhiō Highway. Because Kūhiō Highway is not a source of contaminants, it is unlikely that the path for non-motorized users will have an adverse effect on water quality.

Impacts from non-point source pollution from construction activities will be minimized by implementation of best management practices. For the long term operation and maintenance of the path, impacts from non-point source pollution will be addressed by adjacent planting strips and vegetation.

4.1.6 Natural Hazards

Tsunami and Flood

The Hawaiian Islands have a history of destructive tsunamis. Since 1819, 22 severe tsunamis have occurred, with runup heights at varying locations throughout the islands ranging from 4 to 60 feet. Four tsunamis have occurred in recent history, taking place in 1946, 1957, 1960, and 1964. The tsunami runup height at any given Hawai‘i coastline location during an occurrence varies greatly. The height is affected by a number of factors including offshore bathymetry, coastal configuration, and exposure to the generating area. In the project area, the runup for the 1957 tsunami ranged from 9.5 to 20 feet, and 5 to 7 feet for the 1960 tsunami (Loomis, 1976). Limited data exist for the 1946 and 1964 tsunamis. The only data points in the project area for those two tsunamis are on the northern side of the Wailua River. The data show runup heights of 20 and 4 feet for the 1946 and 1964 tsunamis, respectively.

Tables and methods in the *Manual for Determining Tsunami Runup Profiles on Coastal Areas of Hawaii* (M&E Pacific, Inc., 1978) show the predicted 10-year tsunami runup height for the project area is 2 to 4 feet above mean sea level. The methodology in the manual has been used to develop the shoreline classifications for the Flood Insurance Rate Maps (FIRM) for the state.

The FIRM for the region shows that the shoreline along most of the shared use path is classified Zone VE with a base flood elevation ranging from 8 to 15 feet (see Figure 15). Zone VE is a “Coastal High Hazard Area where wave action and/or high velocity water can cause structural damage in the 100-year flood,” and is primarily identified as an area where a 3-foot or greater wave height could occur (Federal Emergency Management Agency, 1995).

Hurricanes and Swells

Four primary wave types can describe the prevailing Hawaiian wave climate: northeast tradewind waves, North Pacific swell, south swell, and Kona storm waves. The project area is partially sheltered from south swell and Kona storm waves by the island, and is exposed to North Pacific swell and northeast tradewind waves.

The North Pacific swell is produced by severe winter storms in the Aleutian area of the North Pacific and by mid-latitude low-pressure systems. Although North swells may arrive in Hawaiian waters throughout the year, it is largest and most frequent during the winter months of October through March. The North Pacific swell approach direction is from the west to the north, with periods of 13 to 20 seconds and typical deepwater wave heights of 4 to 10 feet. The windward shoreline is partially sheltered from the approach of the North Pacific swell, and only the more northerly of these swells arrive at the project area.

Northeast tradewind waves may be present in Hawaiian waters throughout the year, and are most frequent in summer months, when they dominate the wave climate on windward shores. They result from the strong and steady tradewinds blowing from the northeast quadrant over long fetches of open ocean. Typical deepwater tradewind waves have periods of 5 to 10 seconds and heights of 3 to 10 feet.

Hurricane Waves

In addition to the two primary wave types, infrequent tropical cyclones may generate large waves, which can impact any coastal area of Hawai‘i. In any given year, one or more hurricanes can be expected to occur in the central North Pacific Ocean. Although hurricanes occur infrequently in the immediate vicinity of Hawai‘i, they do occasionally pass near the islands. Notable recent examples are Hurricane Iwa, which passed within 30 miles of Kaua‘i in 1982, and Hurricane Iniki, which passed directly over Kaua‘i in 1992. Because hurricanes directly impact the Hawaiian Islands at such infrequent intervals, it is difficult to calculate a statistically meaningful return period.

Seismic Activity

Earthquakes in the Hawaiian Islands are primarily associated with volcanic eruptions from the expansion or shrinkage of magma reservoirs, rather than shifts in the earth's crust. The island of Kaua'i is periodically subject to episodes of seismic activity of varying intensity, but available historical data indicates that the number of major earthquakes occurring on Kaua'i have generally been fewer and of lower intensity compared with other islands, such as the Big Island.

Earthquakes cannot be avoided or predicted with any degree of certainty, and an earthquake of sufficient magnitude (greater than 5.0 on the Richter Scale) could cause damage to the path. The Uniform Building Code (UBC) provides minimum design criteria to address potential for damages due to seismic disturbances. The UBC scale is rated from Seismic Zone 1 through Zone 4, with 1 the lowest level for potential seismic induced ground movement. Kaua'i is designated Seismic Zone 1.

Potential Impacts and Mitigation Measures

The coastal portions of the proposed alignment are located in the tsunami inundation zone. The path will also pass over the Wailua River floodway with construction of a cantilevered bike/pedestrian bridge that is attached to the existing cane haul bridge. Since the cane haul bridge does not meet the current freeboard requirement (the space between the top of floodwaters and bottom of the bridge), a bike/pedestrian bridge of comparable height would also lack the requisite height to clear projected flood levels. Signs will indicate potential coastal hazards. In extreme weather conditions, the bike/pedestrian bridge could be closed, similar to beach closures during hurricane or high-wave conditions. Path users will be subject to evacuation orders and other instructions issued by civil defense authorities for the immediate region.

Except for the crossings at Wailua River and Uhelekawawa Canal, the north-south alignment is outside Zone AE for which base flood elevations have been determined. The path will not increase the base flood elevation as specified in 23 CFR Part 650. The path will not impede floodwaters in severe rain events, and shoulders will absorb sheet flow in normal rain events. The design of all bridge structures will be coordinated with relevant Federal, State, and County agencies. The shared use path in the Kawaihau Phase is located close to a drainage way. More detailed hydraulic analysis during the design and engineering phase will be needed to ensure path safety under storm conditions.

Except for bridges, the path is not structural and is not likely to sustain damage from high winds. Storm water and/or high waves may cause flooding in low-lying areas, but these temporary conditions will not have a serious effect on the path. Debris will be cleared and spot repairs made, as necessary.

Based on the UBC rating, there is a small probability of earthquake impacts. All pathways will be constructed in compliance with appropriate seismic standards.

Figure 15: FIRM Map (11 x 17)

Figure 15: FIRM Map (11 x 17) (back)

4.1.7 Noise

Existing noise levels in the project area are consistent with similar urban environments. Traffic along Kūhiō Highway is the primary noise generator. Along the coastline, the ocean waves contribute to the ambient noise level, but is also a factor in masking sources of noise that are less pleasurable to human ears.

Portions of the proposed alignments are located in close proximity to residential areas. According to State Department of Health (DOH) regulations, maximum permissible noise levels for construction equipment during nighttime hours in residential areas is 45 dBA and 55 dBA during daytime hours or the ambient noise level—whichever is higher.

Potential Impacts and Mitigation Measures

Construction-related Noise

Construction-related noise impacts are unavoidable, but will be temporary. Project construction will involve excavation, grading, paving, movement of construction vehicles, and possible pile driving. The various construction activities may generate noise that impacts nearby residential areas. Typical ranges of construction equipment noise vary between 70 and 95 dBA. The actual noise levels produced will be a function of the methods employed during each stage of the construction process. Pile drivers and earthmoving equipment, e.g., backhoes, front loaders, bulldozers, and diesel-powered trucks, will probably be the loudest equipment used during construction. Construction on this project will occur during daytime hours only.

Construction in the coastal sections of the path will affect the resort and condominiums located south of Wailua River (Aloha Beach Resort) and on the north end of Wailua Bay. The main alignment will also go through single-family residential neighborhoods on Niulani Street and Moanakai Road. The canal section of the path is adjacent to less noise-sensitive commercial and industrial land uses. One exception is the small residential cluster around Fernandes Road.

In the Wailua House Lots subdivision, the selected alignment (on the outskirts of the neighborhood) will have lesser noise impacts than the other alternatives considered, which involved construction through the neighborhood.

The shared use path in the Kawaihau Phase will be surrounded by noise-sensitive land uses, including Hundley Heights to the south, Mahelona Hospital to the west, and a State-owned housing complex to the east.

Noise levels are regulated and the contractor will have to ensure that all construction activities comply with the DOH Administrative Rules Chapter 11-46 on Community Noise Control. In cases where construction noise exceeds, or is expected to exceed the DOH’s maximum permissible property line noise levels, the contractor will be required to obtain a

permit from the DOH to operate vehicles, construction equipment, power tools, etc. that emit noise levels in excess of “maximum permissible” levels. Conditions attached to the permit restrict the days and times when construction is allowed. Construction equipment and on-site vehicles that exhaust gas or air will be equipped with mufflers. Construction vehicles are also required to satisfy the DOH’s vehicular noise requirements.

Long-term Noise Impacts

The completed bike/pedestrian path is a travel way that will be restricted to non-motorized modes of transportation. Walking, jogging, bicycling, and battery-operated wheelchairs are relatively quiet. Skating can be noisier, but the number of skaters is expected to be a very small percentage of total users, based on the experience at Lydgate Park and a survey of community members in which only 3% responded that they would like to use the path for skating.³ Nevertheless, the path is a community facility that will attract people and a certain amount of talking and socializing is expected. For the most part, the noise levels generated by this type of activity will not exceed State and federal guidelines and standards.

Noise levels can be more disruptive if they occur late at night or in the early morning hours. Such annoyances are not expected to be pronounced in the resort areas where buildings are equipped with central air conditioning and units are generally locked because of the urban setting. In single-family residential areas where windows may be open, occasional loud noises are not expected to differ from the isolated occurrences that take place on any public street. Where necessary, signs can be installed reminding users about path etiquette and courtesy toward neighbors. A more pro-active option is a public education campaign to disseminate this message, if warranted by the number and frequency of noise complaints.

4.1.8 Hazardous Materials

A Phase I Environmental Site Assessment (Phase 1 ESA) was conducted in 2003 for the proposed Kapa‘a Relief Route project (Kimura International, Inc., 2003). The purpose of the Phase 1 ESA is to identify the presence of recognized environmental conditions as defined by the American Society for Testing and Materials (ASTM) Practice E 1527-00. Data on potential sources of ground contamination were obtained through searches of commercial and government databases, review of files and records maintained by the Department of Health, site reconnaissance, and interviews.

In the DEA, nine sites from that study were identified as being of potential concern; however, the path alignment is in proximity to only one of those sites: the Shell Service Station at the corner of Papaloa Road and Kūhiō Highway. The service station is in active operation and does not pose a known hazard to construction and operation of the path.

³ Survey taken at the first public information meeting held on January 29, 2005.

4.2 BIOLOGICAL ENVIRONMENT

4.2.1 Flora

The plant names used in this assessment follow Wagner *et al.* (1990) and Wagner and Herbst (1999). The few recent name changes are those reported in the Hawaii Biological Survey series (Evenhuis and Eldredge, eds., 1999-2002).

Makai Corridor

The start of proposed bike/pedestrian path is located between the Aloha Beach Resort parking lot and Kūhiō Highway. The vegetation in this area is primarily a grassy lawn with a few landscape plantings. Between the hotel property and the Wailua River, the vegetation consists primarily of Bermuda grass (*Cynodon dactylon*) and pitted beardgrass (*Bothriochloa pertusa*). Overgrown weedy areas support patches of swollen fingergrass (*Chloris barbata*), nodeweed (*Synedrella nodiflora*), and false mallow (*Malvastrum coromandelianum*). The path will skirt a small area with koa haole shrubs (*Leucaena leucocephala*), California grass (*Brachiaria mutica*), castor bean (*Ricinus communis*), and a few coconut trees (*Cocos nucifera*) before joining the existing cane haul bridge.

From just past the bridge to about the Seashell Restaurant, the path follows along the makai side of a rock wall along a sandy beach. The vegetation consists of scattered trees of hala (*Pandanus tectorius*), coconut, ironwood (*Casuarina equisetifolia*), and tree heliotrope (*Tournefortia argentea*). Low thickets of beach naupaka or naupaka kahakai (*Scaevola sericea*), 2 to 3 feet tall, are abundant, while beach morning glory or pohuehue (*Ipomoea pes-caprae*) forms extensive mats seaward of the line of trees. Locally common are mats of ‘aki‘aki grass (*Sporobolus virginicus*) and beach pea or nanea (*Vigna marina*).

In the Waipouli resort area, the landscape alternates between properties with extensive lawns and undeveloped parcels. Through the undeveloped parcels, existing dirt paths follow along the shoreline. A thin line of ironwood trees along with a few tree heliotrope and beach naupaka shrubs are found along the seaward side of the undeveloped parcels. Bermuda grass forms low mats along the dirt pathways.

At Ala Road, the proposed bike/pedestrian path is located in the road right-of-way through a residential area and to a beach park at Waika‘ea Canal. At the beach park, the vegetation is again composed of salt-spray tolerant strand species such as ironwood, tree heliotrope, beach naupaka, sea grape (*Coccoloba uvifera*), Bermuda grass, pohuehue, and ‘aki‘aki.

Mauka Canal Corridor

The proposed canal section starts north of Wailua Shopping Plaza, using the roadbed of a former cane haul road. After crossing the temporary bypass road, the shared use path will run parallel to the makai bank of the Waipouli Drainage Canal.

The vegetation is variable. Between Wailua Shopping Plaza and the temporary bypass highway, the path follows a raised roadbed through a small wetland covered with California grass and clumps of bulrush (*Schoenoplectus californicus*) and Job’s tears (*Coix lachryma-jobi*). From the bypass highway to Waipouli Town Center, the proposed path passes an excavated wetland (former sand quarry pit) and follows along Waipouli Drainage Canal. The vegetation along this section is largely koa haole thicket with dense clumps of Guinea grass or mats of California grass between the woody components. A few Java plum trees (*Syzygium cumini*) are occasionally found here.

Wailua House Lots Phase

This path begins behind the Wailua Shopping Plaza and proceeds upslope, following along the north side of the Wailua House Lots subdivision on private property. A narrow band of scrub vegetation borders the residential area and the cane haul roads. It is made up mainly of tall clumps of Guinea grass, 7 to 10 feet high, with scattered shrubs of sourbush and castor bean and Java plum trees.

The cane haul roads are in good shape in most places with only a few scattered patches of weeds. These consist of plants such as young Guinea grass, false ragweed (*Parthenium hysterophorus*), pualele (*Emilia fosbergii*), molasses grass (*Melinis minutiflora*), sowthistle (*Sonchus oleraceus*), white-flowered beggar’s tick (*Bidens alba*), partridge pea (*Chamaecrista nictitans*), fimbriate paspalum (*Paspalum fimbriatum*), wedelia, etc. In some places, the residents have trimmed back the band of scrub vegetation.

An irrigation ditch with running water and overgrown sugar cane fields are found on the north side of the cane haul road. On these abandoned fields, sugar cane (*Saccharum officinarum*) makes up about 50% of the plant cover, while Guinea grass, California grass, and young koa haole shrubs make up the remaining cover. A few Christmas berry (*Schinus terebinthifolius*), guava (*Psidium guajava*), and castor bean shrubs are occasionally encountered.

Kawaihau Phase

This path connects lower Kawaihau Road, near the Jodo Mission, to ‘Iwa‘ena Road and will connect to the existing Kawaihau Bike/Pedestrian Path.

The proposed alignment will pass through the gully, which is an overgrown area covered by dense koa haole and Christmas berry thickets, 10 to 15 feet tall. Guinea grass and Chinese violet (*Asystasia gangetica*) form a thick layer between the woody components. Near the lower Kawaihau Road end and about half way up the property, there are a few coconut palms. A few stands of Java plum, ironwood, and autograph tree (*Clusia rosea*) are found on the steeper slopes. As the proposed path approaches ‘Iwa‘ena Road, the vegetation changes to open, grassy pasture land.

Potential Impacts and Mitigation Measures

In the developed portions of the proposed bike/pedestrian paths, the vegetation consists of grassy, maintained lawns with landscape plantings. Undeveloped areas support a varied assortment of vegetation types or plant communities. Along the shoreline on sandy substrate, strand vegetation with a number of native species is found. Along the mauka canal section, nearby wetlands are dominated by California grass for the most part, while koa haole and Guinea grass scrub or weedy patches occur on dryland areas. The proposed path, however, does not go through any wetland.

The proposed Wailua House Lots path will be near overgrown sugar cane fields—although it should be noted that an irrigation ditch will separate the path from the undeveloped land to the north. Dense, tall koa haole/Christmas berry thicket is found in the gully area of the Kawaihau path.

None of the plants observed within the proposed path alignments is a threatened and endangered species or a species of concern (U.S. Fish and Wildlife Service 1999a, 1999b; Wagner et al. 1999). All of the native species encountered can be found in similar environmental habitats throughout the Hawaiian Islands.

The proposed construction of the Lydgate-Kapa‘a Bike/Pedestrian Path (including the connector paths to the residential areas) is not expected to have a negative impact on the botanical resources. However, the following mitigation measures will be implemented:

- Landscaping material used along the shoreline areas of the makai path will consist of native plants to the extent possible. Native strand plants, such as beach naupaka, pohuehue, ‘aki‘aki grass, and nanea, are adapted to the harsh environmental conditions along the shoreline. These plants are common to abundant within the study area and they are easily propagated through cuttings and plugs.
- The Kawaihau connector path to Gore Park will require extensive clearing of the koa haole/Christmas berry thicket to open it up and make it more visible for safety’s sake. The areas cleared of vegetation will be grassed over as soon as possible to prevent soil erosion and runoff of sediment into the drainage culvert located at the lower end of the gulch.

4.2.2 Terrestrial Fauna

Several avian and mammalian surveys have been conducted in the project area over the past few years. Therefore, in light of the relatively large project corridor, intensive counts were taken for this project during a survey in March 2004, but limited to proposed coastal routes located makai of Kūhiō Highway. Lower intensity reconnaissance level surveys were conducted within Wailua House Lots. No new surveys were conducted for the canal route, or the Kawaihau connector routes. However, in the latter two cases, data are available from biological surveys conducted for the proposed Kapa‘a Relief Route and the

Kapa‘a-Keālia Bike/Pedestrian Path, and other recent studies in the general project area (David 2002, 2003; Day et al. 2001, 2002).

Mammalian Survey Results

Endangered Hawaiian hoary bats were seen on both nights of the March 2004 survey. Three bats were seen simultaneously from the bridge crossing the Wailua River at the southern terminus of the project. Additionally, two animals were seen foraging over the near-shore area in front of the Bull Shed Restaurant, just south of the Uhelekawawa Canal.

Three alien mammalian species (rat, dog, and cat) were encountered in the coastal area and in the Wailua House Lots subdivision.

Avian Survey Results

Coastal Area, Makai of Kūhiō Highway

A total of 339 individual birds of 17 species, representing 14 separate families were recorded during station counts. Of the 17 species detected in the coastal area, two species—Pacific Golden Plover (Pluvialis fulva) and Ruddy Turnstone (Arenaria interpres) are indigenous migratory species commonly found throughout the state during the winter months. The other 15 species detected are alien to the Hawaiian Islands. No avian species that is either listed, or proposed for listing under either the federal or State of Hawai‘i’s endangered species programs was detected in the coastal area during the course of the survey.

Avian diversity was relatively low in the coastal area. Three species, Zebra Dove (Geopelia striata), Common Myna (Acridotheres tristis), and House Sparrow (Passer d. domesticus), accounted for 44% of the total of all birds recorded during station counts. The most common avian species detected was the House Sparrow, which accounted for 10% of the total number of individual birds recorded. An average of 56 birds was recorded per station count.

The findings of the avian survey were consistent with the findings of other recent surveys conducted within the lowland areas of Kauai (David, 1995, 1998, 1999a, 1999b, 2000, 2001, 2002, 2003; Day and Cooper, 1999, 2001; Day et al., 2000, 2001, 2002). Due to the timing of the field survey neither the endangered Hawaiian Petrel (Pterodroma sandwichensis) or ‘ua‘u nor the threatened endemic sub-species of the Newell’s Shearwater (Puffinus auricularis newelli) or ‘a‘o were detected flying over the project site. Both of these species are pelagic seabirds which do not return to their breeding colonies until late April. Both species cross the northern, eastern, and southern coastline of Kaua‘i across a broad front and in relatively large numbers during the breeding season, and both have been recorded over-flying all areas of the project site.

Wailua House Lots

In the Wailua House Lots area, a total of 180 individual birds of 19 species, representing 15 separate families were recorded during station counts. Of the 19 species detected, one, the White-tailed Tropicbird (Phaethon lepturus dorothea) or koa‘e kea, is an indigenous nesting seabird, and one, the Pacific Golden Plover or kōlea, is an indigenous migratory shorebird species. The other 17 species detected are alien to the Hawaiian Islands. No avian species that is either listed, or proposed for listing under either the federal or State of Hawai‘i’s endangered species program was detected in this area during the survey.

Avian diversity was also relatively low within the Wailua House Lots area. Four species, Zebra Dove, Common Myna, Red Junglefowl (Gallus gallus), and Cattle Egret (Bubulcus ibis), accounted for 38% of the total of all birds recorded during station counts. The most common avian species detected was the Common Myna, which accounted for 75 of the total number of individual birds. There was an average of 60 birds recorded per station count.

Canal Area Mauka of Kūhiō Highway

The results for this area are based on data collected and analyzed in May 2003. The field survey efforts were part of the environmental baseline for the proposed Kapa‘a Relief Route. A total of 2,146 individual birds of 27 species, representing 20 separate families were recorded during station counts. An additional five species representing three additional families were recorded as incidental observations during time spent within the area.

Two of the species detected during station counts: the Hawaiian Duck (Anas wyvilliana) or koloa and Hawaiian Coot (Fulica alai) or ‘alea ke‘oke‘o are endangered endemic (i.e., native and unique to Hawaii) species. Two others, the Common Moorhen (Gallinula chloropus sandvicensis), or ‘alea‘ula and Black-necked Stilt (Himantopus mexicanus knudseni) or ae‘o are endemic endangered sub-species of more cosmopolitan continental species. All four species are protected under both the federal Endangered Species Act (ESA) of 1973, as amended, and by the State of Hawai‘i under its endangered species program.

One species detected during station counts, the Short-eared Owl (Asio flammeus sandwichensis) or pueo is an endemic sub-species which is listed by the State of Hawaii as endangered on O‘ahu, but not on Kaua‘i. The owl is not listed under the federal ESA. Two additional species: White-tailed Tropicbird and Black-crowned Night Heron (Nycticorax nycticorax hoactli) or ‘auku‘u are relative common indigenous breeding species. Three other indigenous breeding seabird species: Wedge-tailed Shearwater (Puffinus pacificus chororhynchus) or ‘ua‘u kani, Red-footed booby (Sula s. rubripes) or ‘a, and Great Frigatebird (Fregata minor palmestroni) or ‘iwa were detected as incidental observations while traversing portions of the survey area.

Potential Impacts and Mitigation Measures

Mammals

The endangered Hawaiian hoary bat is regularly seen in and around Kapa‘a, as well as most of the lowland areas on Kaua‘i (Tomich, 1986; David, 1995, 1999b, 2001, 2002, 2003; R. David, personal observations 1980-2002). It is highly unlikely that the construction of proposed pathway will have any impact, deleterious or otherwise, on this species.

Aquatic Fauna

The endangered Hawaiian monk seal (*Monachus schauinslandi*) is known to haul out occasionally in the intertidal zone and on the beach in the project area. Both the federal and State of Hawai‘i wildlife agencies have an ongoing and very comprehensive outreach and protection program to ensure that seals are not disturbed while in near-shore waters or when they are basking on land. Consultations with the U.S. National Marine Fisheries Service led to an acceptable set of mitigation measures to minimize potential human interaction with monk seals. Because of the County’s shoreline setback requirement, the shared use path will have a measure of separation from the waterline. Users who stay on the path are highly unlikely to be in proximity to a hauled out seal. In the event a seal has hauled out at Wailua Beach Park or Lihi Park, signs, information distributed by the Monk Seal Watch program, and temporary fencing will instruct people on how to pass safely above (mauka of) the animals and take other cautionary actions.

Similarly, while the threatened green sea turtle (*Chelonia mydas agassizii*) occasionally hauls out in the intertidal zone of the coastline, the path is not located in areas where sea turtles would be impacted.

Birds

The two species of endangered seabirds: the endangered Hawaiian Petrel (*Pterodroma sandwichensis*) or ‘ua‘u and the threatened endemic sub-species of the Newell’s Shearwater (*Puffinus auricularis newelli*) or ‘a‘o are found in relatively large numbers during the breeding season. Both species of seabirds, especially fledging birds, can become disoriented by exterior lighting between nesting sites and the sea. This project, however, does not involve the installation of new exterior lighting.

Four of the five endangered Hawaiian waterbird species currently found on Kaua‘i, namely Hawaiian Duck, Hawaiian Coot, Common Moorhen, and Black-necked Stilt were detected in and around the canals and wetlands in the inland canal corridor, located west of the Waipouli Town Center and the Kaua‘i Village Shopping Center during surveys conducted in 2003. It is also possible that the endangered Nēnē (*Branta sandvicensis*) uses resources in the pastures and wetlands in the area mauka of Kūhiō Highway as well. Because the

path will not encroach into the wetlands or canals, it is unlikely that there would deleterious impacts on any of the endangered waterbird species.

To maintain the water quality necessary to support both listed waterbirds and near-shore waters that supported listed aquatic fauna, Best Management Practices will be developed and implemented during the construction phase of the project to prevent spoils from entering the streams, canals, or near-shore waters adjacent to the proposed path.

4.2.3 Stream Fauna

All alternatives being considered under the proposed action will need to cross the Wailua River, Uhelekawawa Canal, and possibly other smaller canals and ditches in the Waipouli drainage system. This section includes a description of the aquatic environment for various stream fauna. The information is based primarily on an aquatic biological assessment prepared by Michael H. Kido for the proposed Kapa‘a Relief Route. The bike/pedestrian path project corridor occupies a portion of the larger Kapa‘a Relief Route study area.

Wailua River

The Wailua River has one of the largest deep-water estuaries (in length and volume) in Hawai‘i and has been long utilized for recreational and commercial tour boat activities. The estuary receives stream water from no less than fifteen tributaries.

Salinity readings near the Wailua Boat Ramp (Department of Health Station #822) indicate a typical deep-water Hawaiian estuary function with a variable salt-water wedge that intrudes into up-river areas and retreats toward the ocean depending on the balance between river flow and ocean conditions. Measurements at this station have also found elevated enterococcus levels, indicating chronic nonpoint source pollution of the estuary from cesspools, septic tanks, and other sources of sewage in the watershed. The Wailua estuary, therefore, is strongly influenced by human activities, serving as a repository for organic waste and other discharged pollutants.

The lowland drainage canals and other waterways that empty into the Wailua estuary are infested with invasive tilapia, primarily Oreochromis mossambicus, although other tilapia species may also be present. Tilapia likely prey upon and compete for habitat with native stream and estuarine species, thereby resulting in low levels of native species in the estuary. In the sandy areas closer to the ocean, four brackish water native fish species were observed during visual surveys; however, areas slightly upstream of the mouth were dominated by large O. mossambicus. Tilapia, therefore, are clearly the dominant fish species in the lower Wailua River and have invaded streams throughout low gradient areas of the watershed and is one of the leading causes of biotic integrity impairment.

Kapa‘a Floodplain and Canal System

Two primary waterways and associated drainage systems are located in the Kapa‘a floodplain. The Waipouli/Waika‘ea canal system is located in the project area, but the Mo‘ikeha canal system is outside the project area. The floodplain mauka of Waipouli-Kapa‘a, has been highly modified historically by the sugarcane plantations that constructed numerous reservoir, stream diversions, and irrigation ditches that today empty into three major canals that discharge into the ocean. Waipouli Canal and Waika‘ea Canal drain a watershed area of about 2.3 square miles and is bordered by Nounou Mountain and Olohena Road.

There are no natural stream habitats in the Kapa‘a floodplain and all drainage canals are highly sedimented, slow moving, and (in the lowland) devoid of riparian zones. Like the Wailua estuary, the canal systems are infested with alien species including various Poeciliid species and at least one species of tilapia. Populations of native aholehole, however, are common at the mouths of the canals at the freshwater-ocean interface and it is likely that other itinerant fish species like mullet enter these limited coastal areas regularly.

Potential Impacts and Mitigation Measures

Benthic Environment

A substantial effort in Kido’s study was focused on locating populations of the endangered aquatic snail, Newcomb’s Snail (*Erinna newcombi*), using both underwater visual observation and standard benthic sampling methodologies; however, no individuals were observed. Given the degraded waterways inhabited by large populations of alien predatory fish species, this outcome is not surprising. There is little potential for impact to this federally listed endangered species from proposed construction of the path.

River and Canals

The Wailua River and canal system are severely impaired from both habitat, as well as biotic integrity perspectives, and this environment does not provide adequate support for native species. Therefore, with implementation of Best Management Practices, concerns for potential adverse impacts to populations of native stream species from project construction activities are minimal.